Fig.1

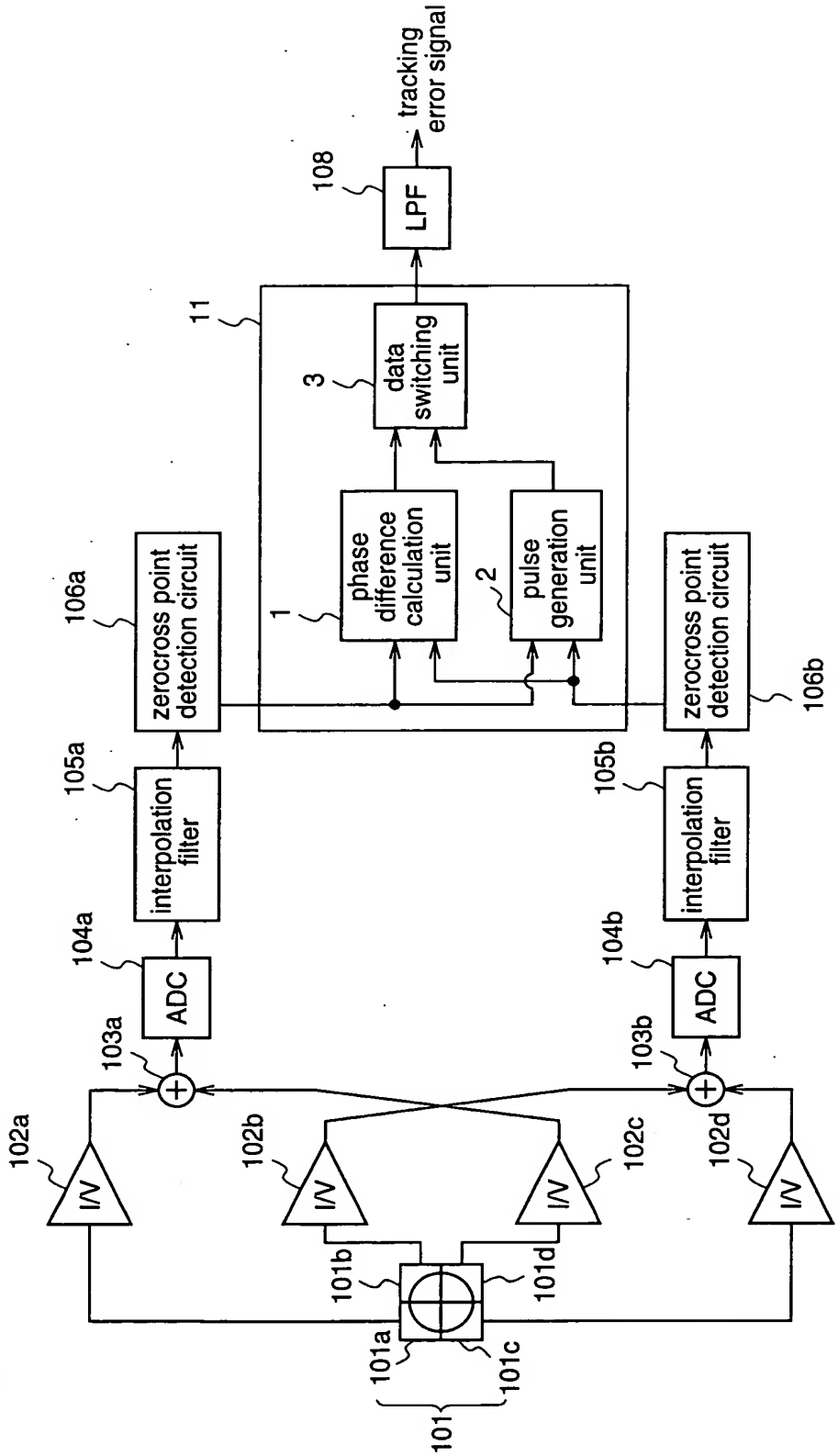
tracking error signal
108
LPF
11
3
data switching unit
1
phase difference calculation unit
2
pulse generation unit
106a
zerocross point detection circuit
106b
zerocross point detection circuit
105a
interpolation filter
105b
interpolation filter
104a
ADC
104b
ADC
103a
103b
102a
102b
102c
102d
I/V
I/V
I/V
I/V
101b
101d
101a
101c
101

Fig.2

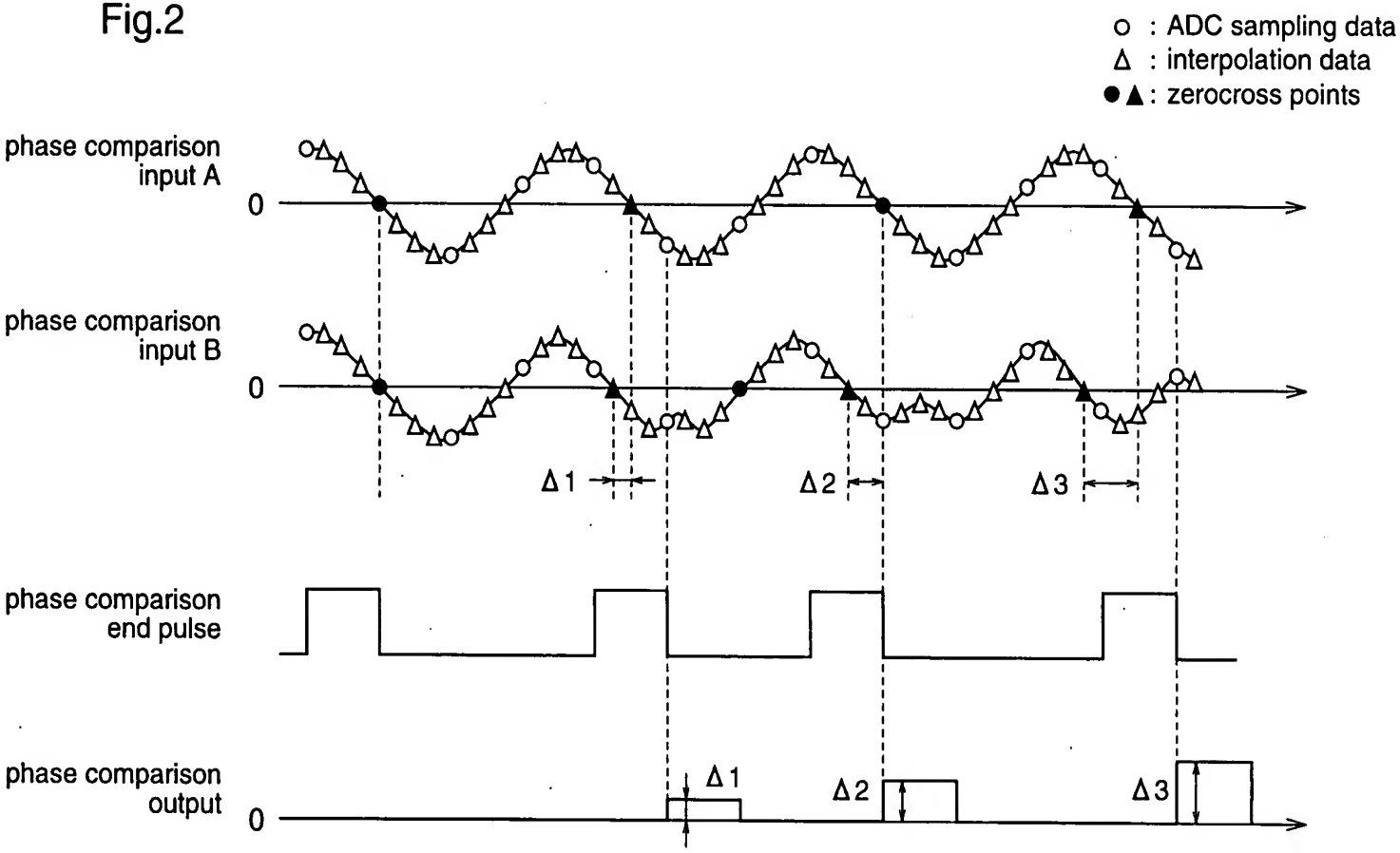
○ : ADC sampling data
△ : interpolation data
●▲ : zerocross points
phase comparison input A
0
phase comparison input B
0
Δ1
Δ2
Δ3
phase comparison end pulse
phase comparison output
0
Δ1
Δ2
Δ3

Fig.3(a)

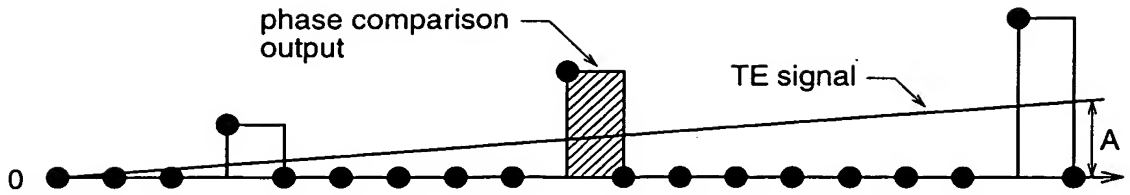
phase comparison output
TE signal
A
0

Fig.3(b)

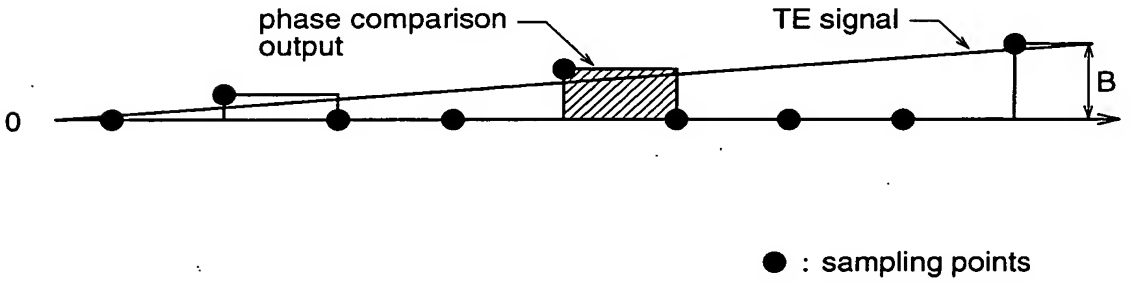
phase comparison output
TE signal
B
0
● : sampling points

Fig.4

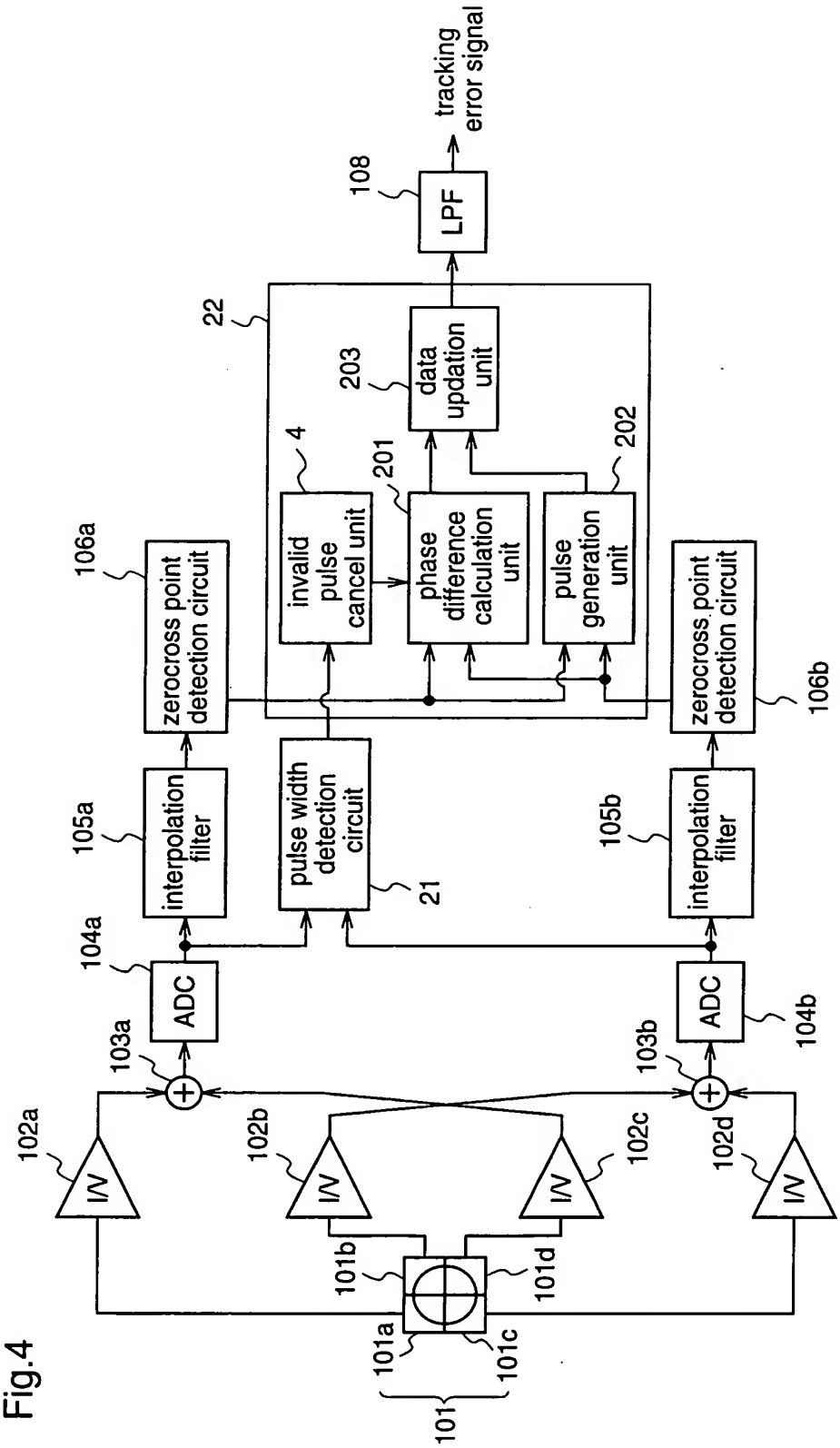
tracking error signal
108
LPF
22
203
data updation unit
4
201
202
invalid pulse cancel unit
phase difference calculation unit
pulse generation unit
106a
zerocross point detection circuit
zerocross point detection circuit
106b
105a
interpolation filter
pulse width detection circuit
21
105b
interpolation filter
104a
ADC
ADC
104b
103a
103b
102a
I/V
102b
I/V
I/V
102c
102d
I/V
101b
101d
101a
101c
101

Fig.5

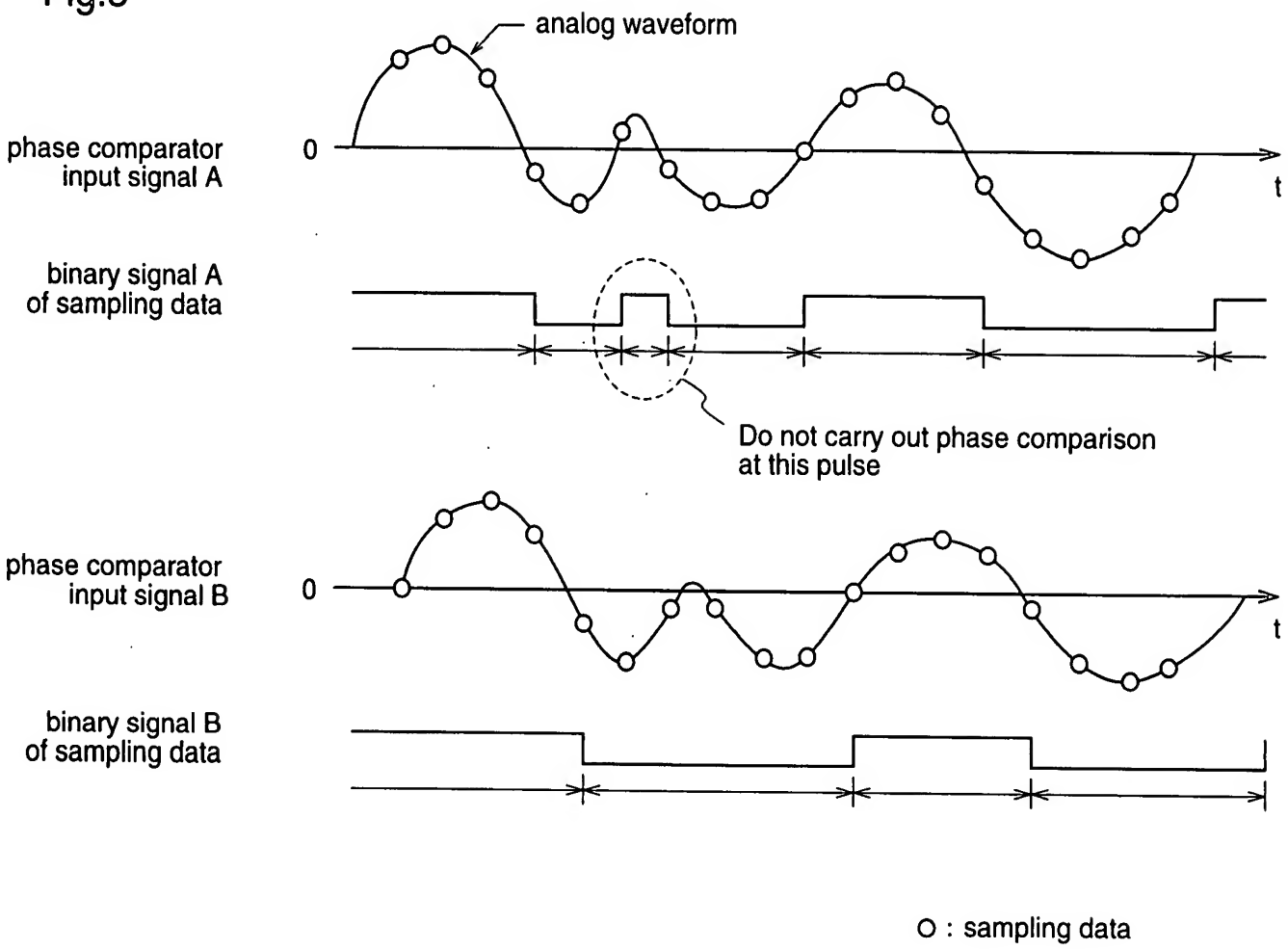
analog waveform
phase comparator input signal A
0
t
binary signal A of sampling data
Do not carry out phase comparison at this pulse
phase comparator input signal B
0
t
binary signal B of sampling data
O : sampling data

Fig.6(a)

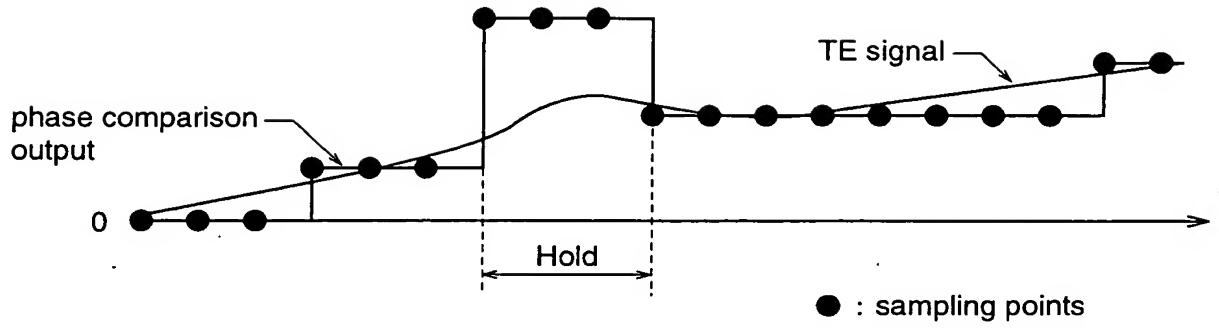
TE signal
phase comparison output
0
Hold
● : sampling points

Fig.6(b)

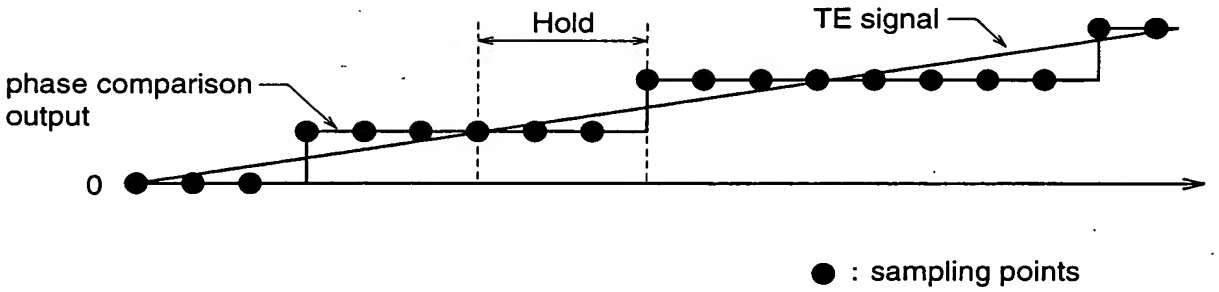
Hold
TE signal
phase comparison output
0
● : sampling points

Fig.7

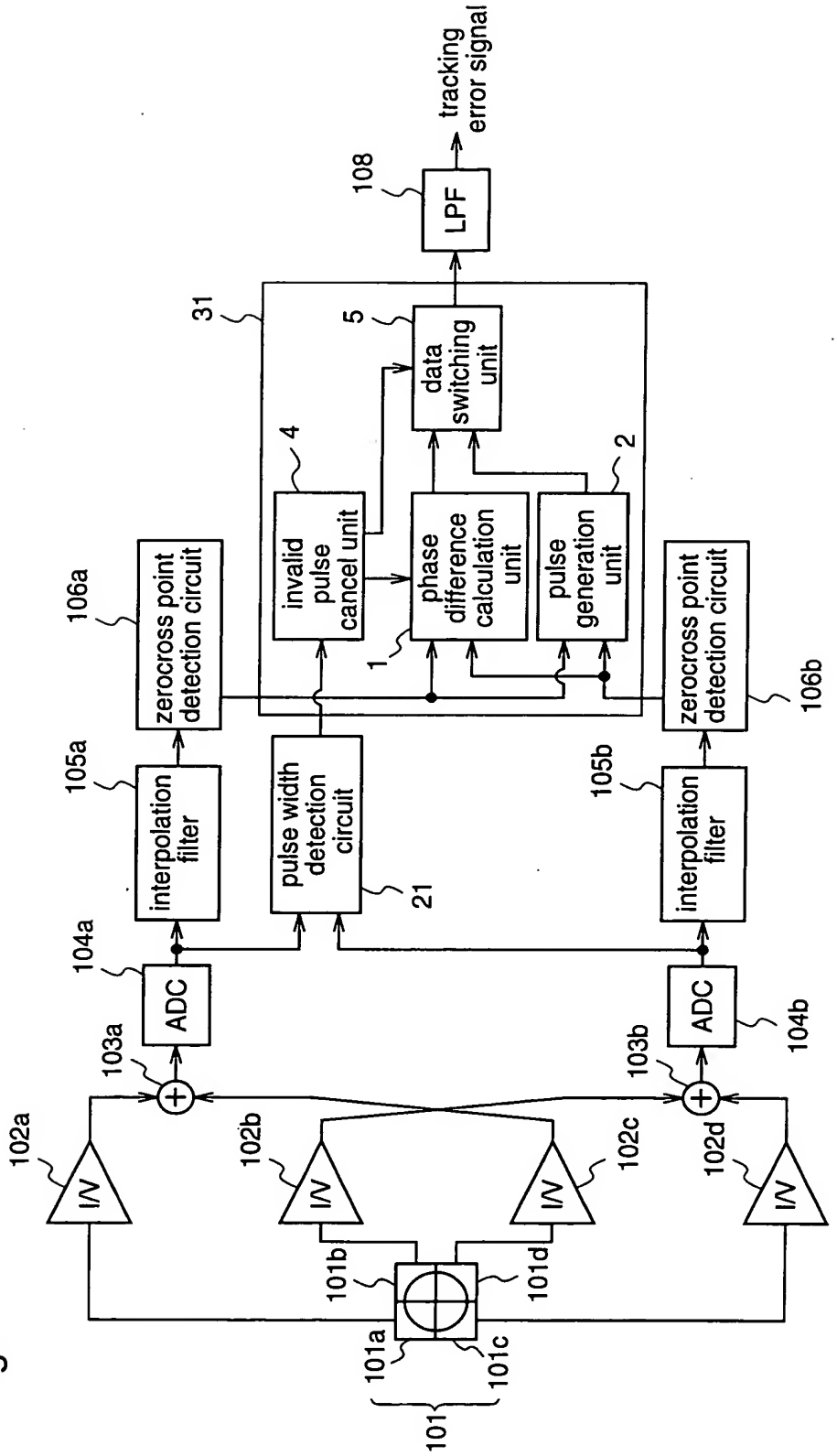
tracking error signal
108
LPF
31
5
data switching unit
4
invalid pulse cancel unit
2
pulse generation unit
1
phase difference calculation unit
106a
zerocross point detection circuit
106b
zerocross point detection circuit
105a
interpolation filter
105b
interpolation filter
pulse width detection circuit
21
104a
ADC
104b
ADC
103a
103b
102a
I/V
102b
I/V
102c
I/V
102d
I/V
101b
101d
101a
101c
101

Fig.8(a)

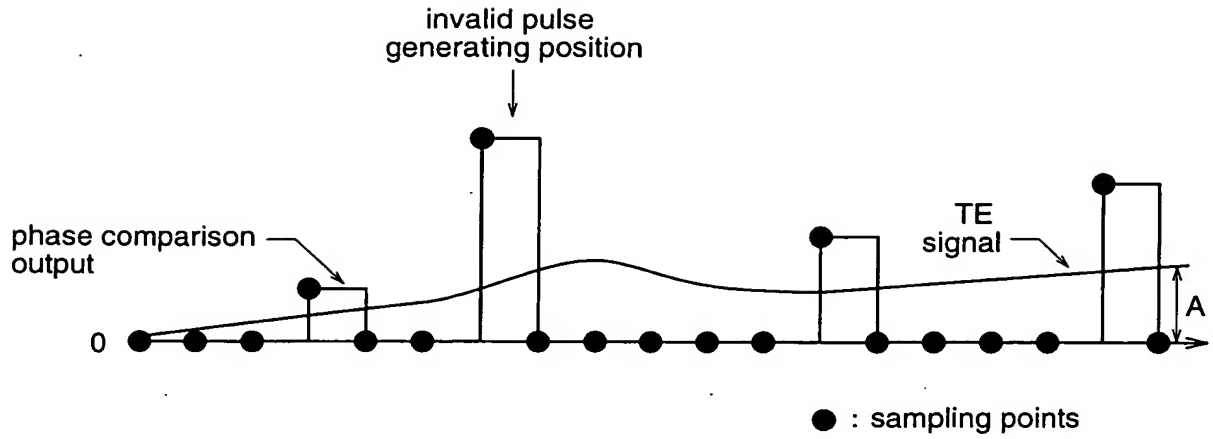

Fig.8(b)

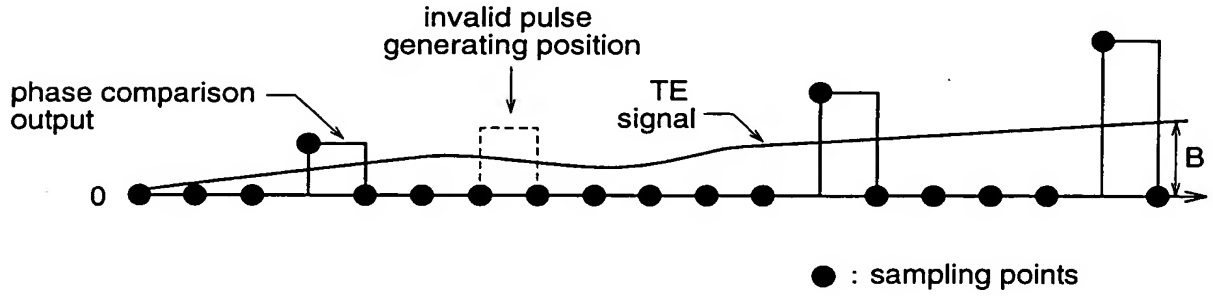

Fig.8(c)

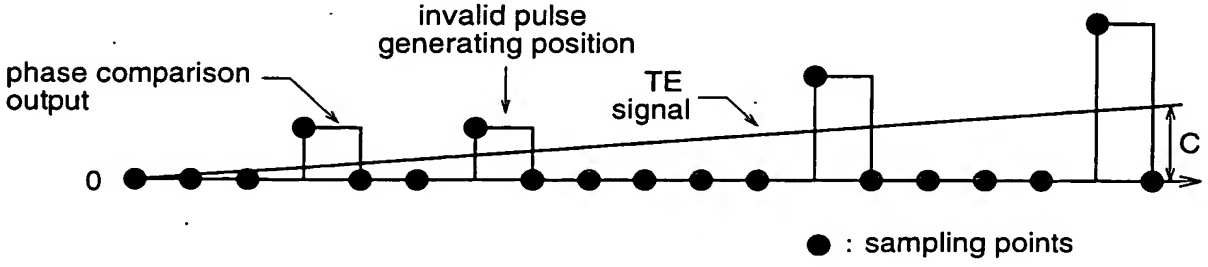

Fig.9

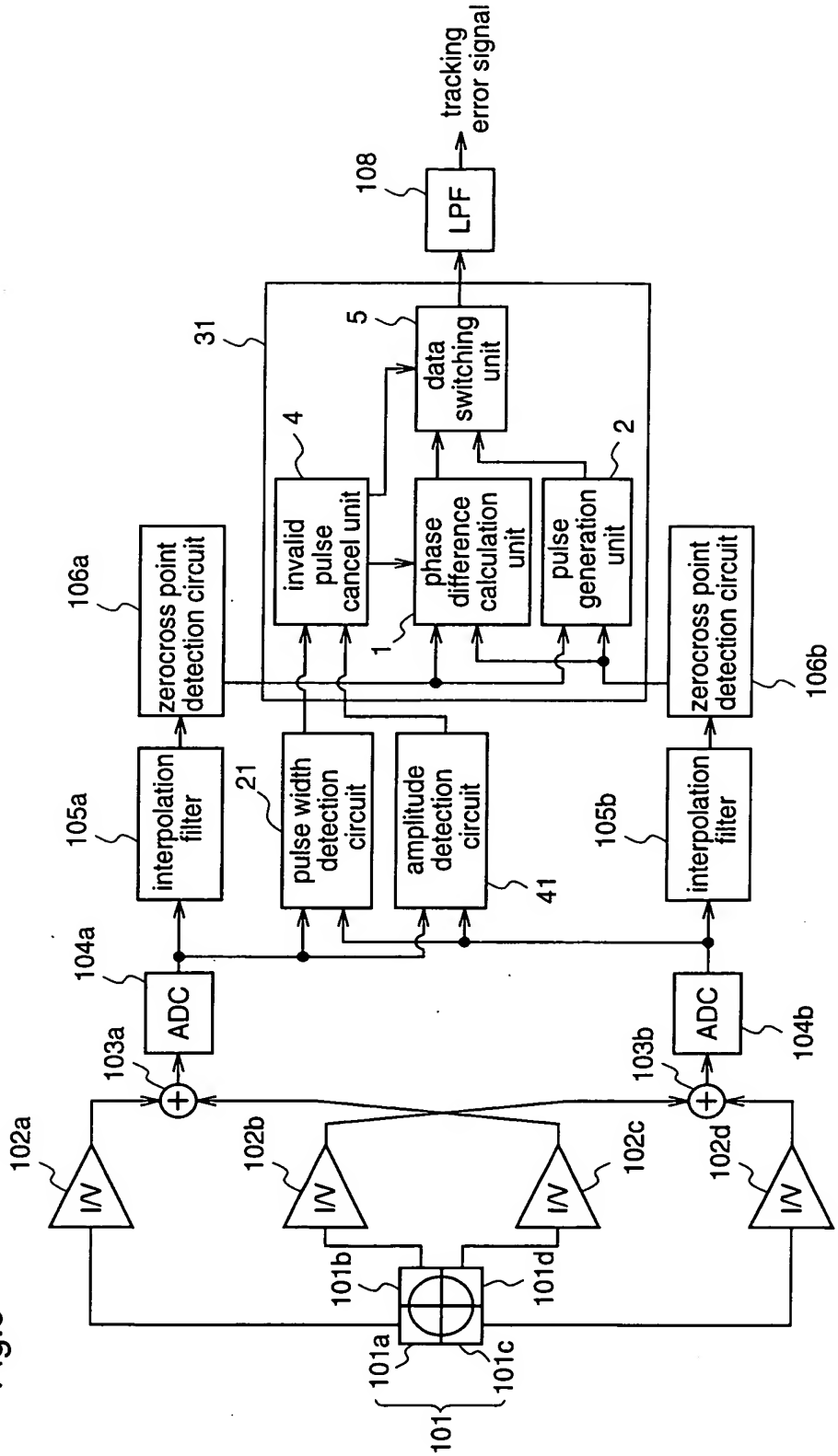
tracking error signal
108
LPF
31
5
data switching unit
4
invalid pulse cancel unit
2
pulse generation unit
1
phase difference calculation unit
106a
zerocross point detection circuit
106b
zerocross point detection circuit
105a
interpolation filter
105b
interpolation filter
21
pulse width detection circuit
amplitude detection circuit
41
104a
ADC
104b
ADC
103a
103b
102a
102b
102c
102d
I/V
101b
101d
101a
101c
101

Fig.10(a)

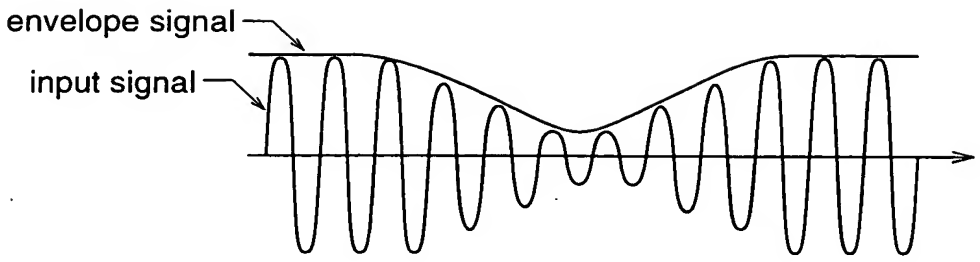

Fig.10(b)

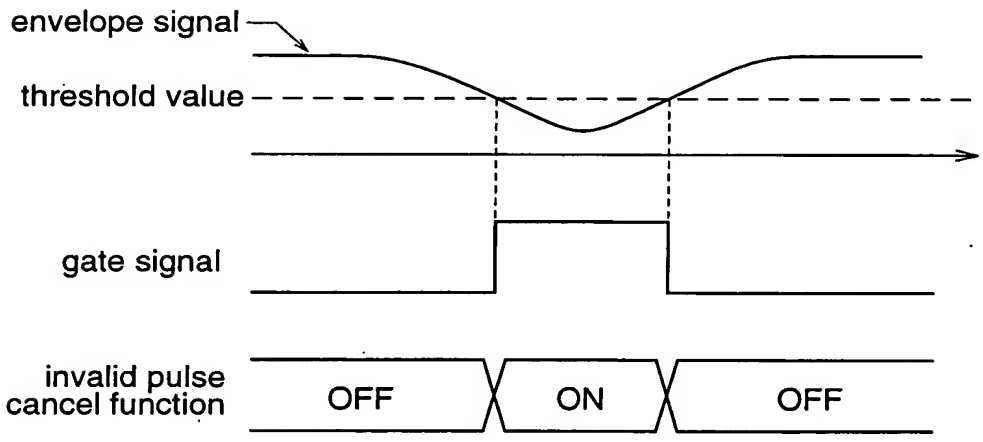

Fig.11

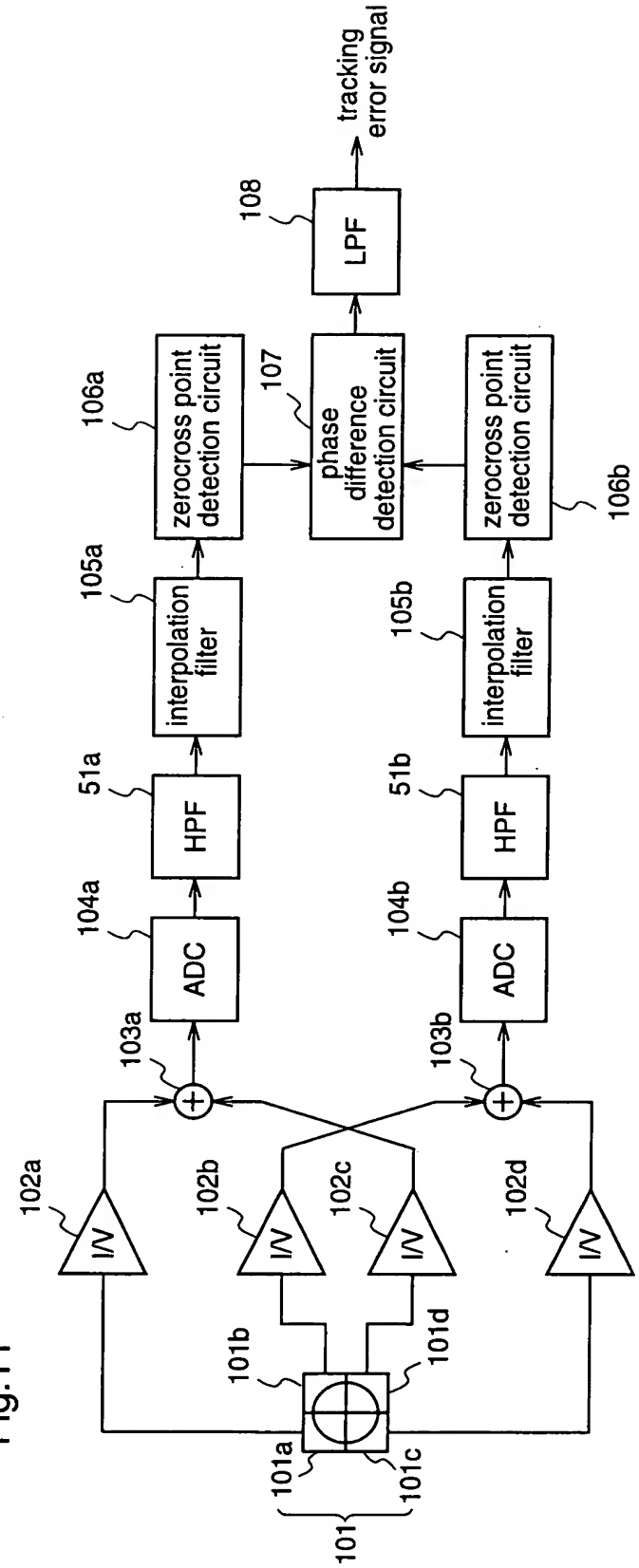
tracking error signal
108
LPF
107
phase difference detection circuit
106a
zerocross point detection circuit
106b
zerocross point detection circuit
105a
interpolation filter
105b
interpolation filter
51a
HPF
51b
HPF
104a
ADC
104b
ADC
103a
103b
102a
I/V
102b
I/V
102c
I/V
102d
I/V
101a
101b
101c
101d
101

Fig.12(a)

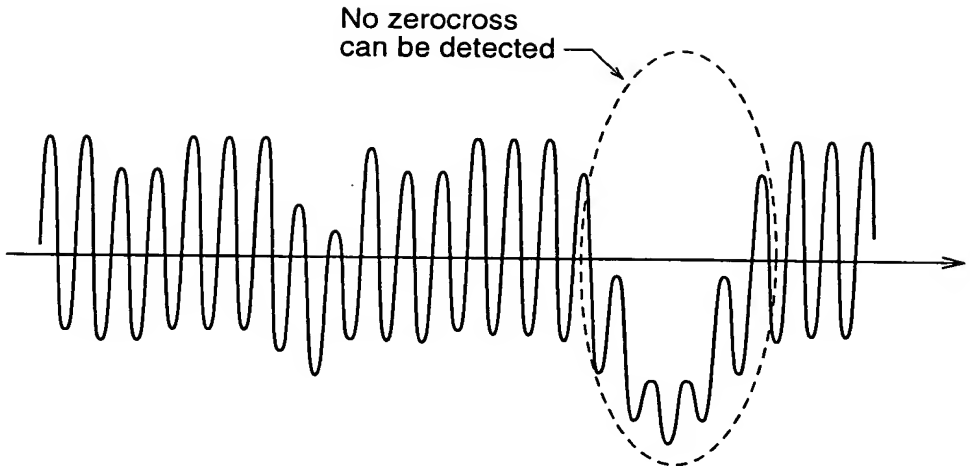

Fig.12(b)

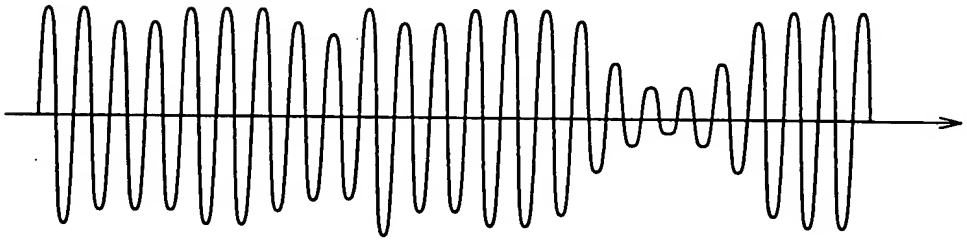

Fig.13

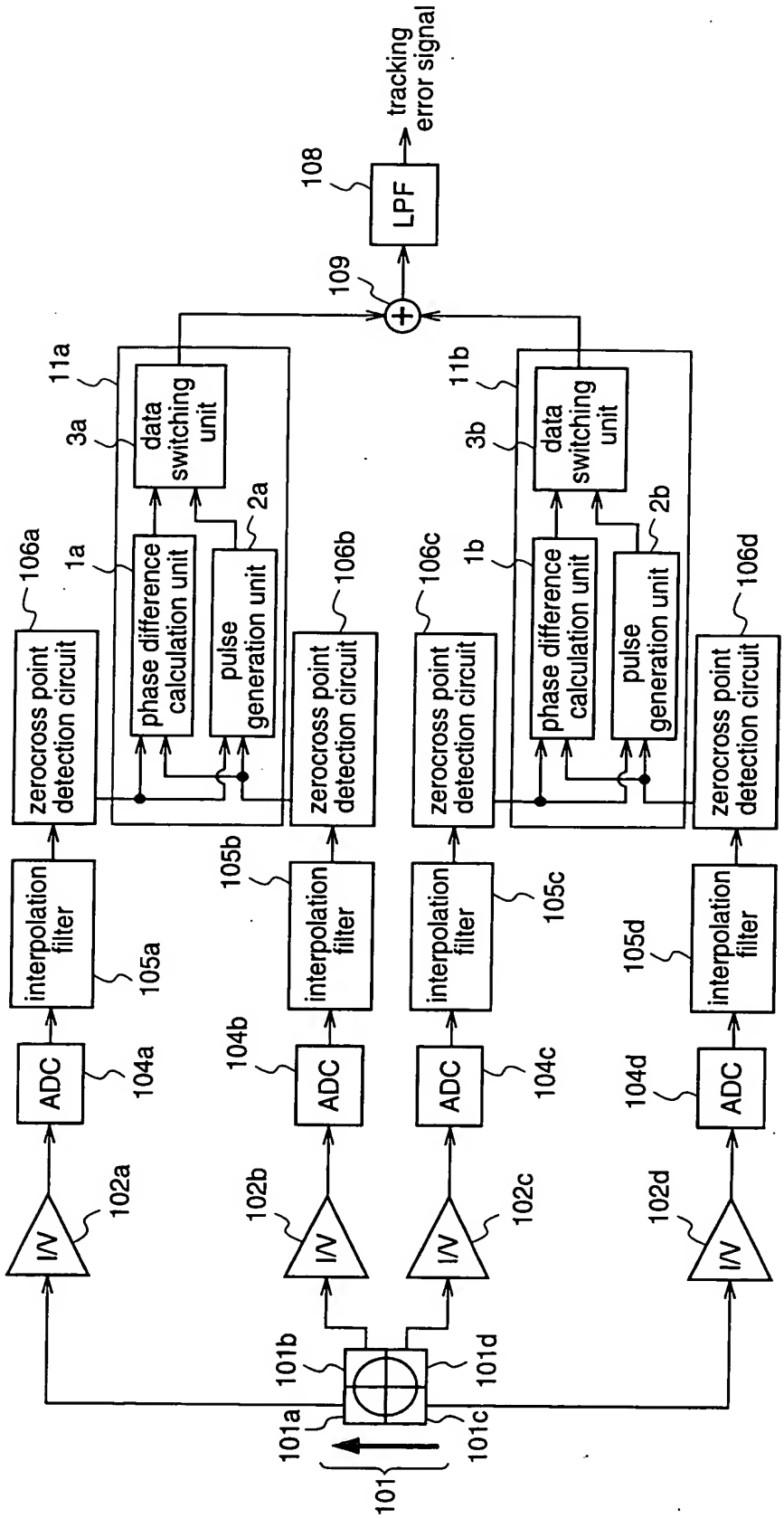
tracking error signal
108
LPF
109
11a
11b
3a
3b
data switching unit
2a
2b
1a
1b
phase difference calculation unit
pulse generation unit
106a
106b
106c
106d
zerocross point detection circuit
105a
105b
105c
105d
interpolation filter
104a
104b
104c
104d
ADC
102a
102b
102c
102d
I/V
101a
101b
101c
101d
101

Fig.14(a)

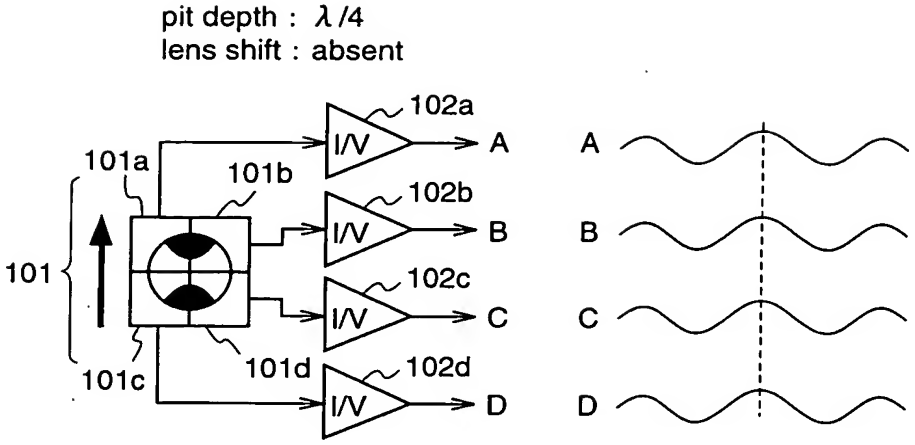

Fig.14(b)

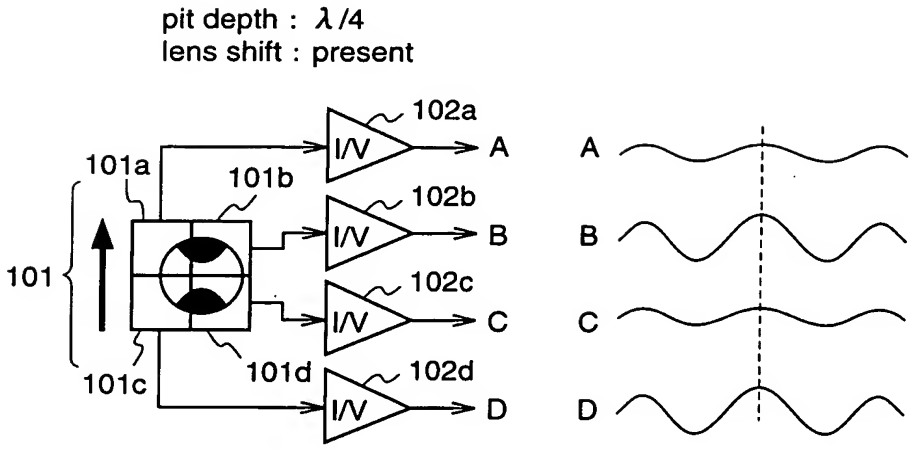

Fig.14(c)

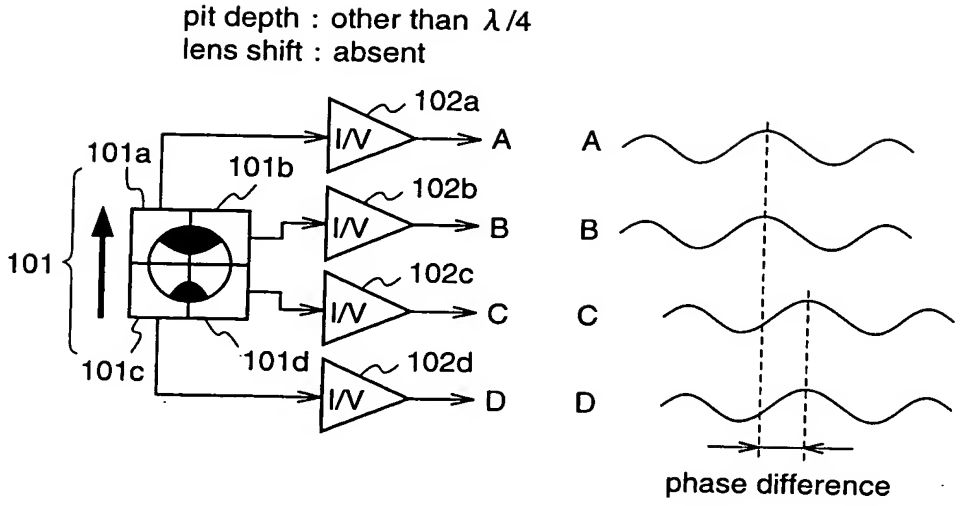

Fig.14(d)

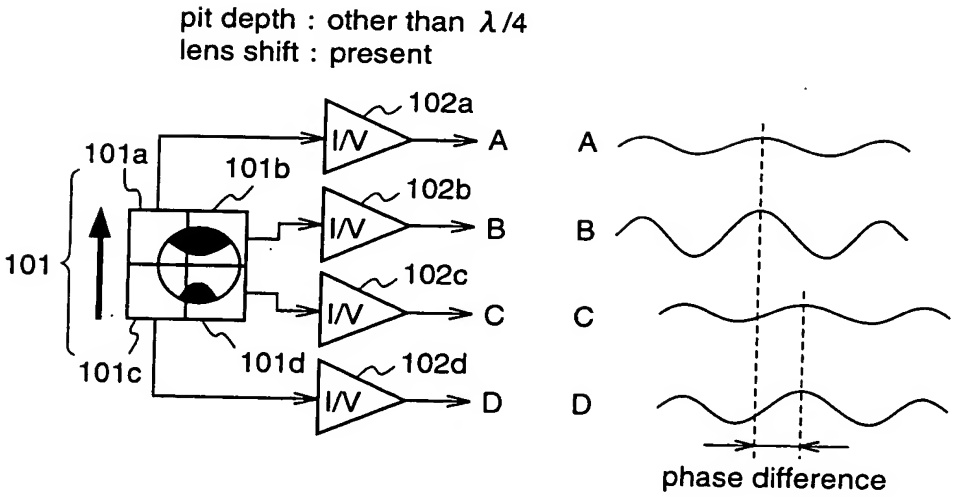

Fig.15

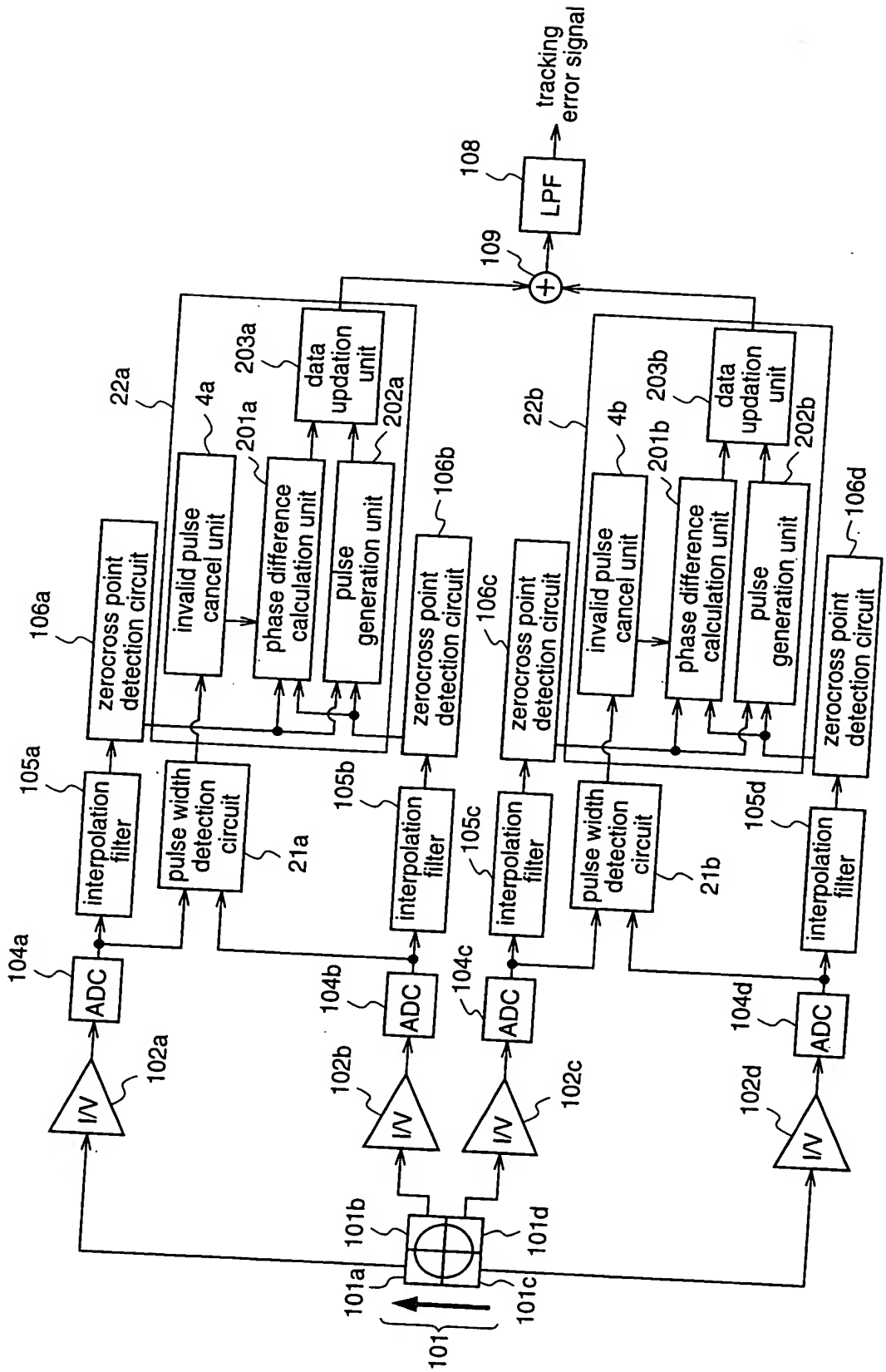
tracking error signal
108
LPF
109
22a
22b
4a
4b
201a
201b
203a
203b
data updation unit
202a
202b
invalid pulse cancel unit
phase difference calculation unit
pulse generation unit
106a
106b
106c
106d
zerocross point detection circuit
105a
105b
105c
105d
interpolation filter
21a
21b
pulse width detection circuit
104a
104b
104c
104d
ADC
102a
102b
102c
102d
I/V
101
101a
101b
101c
101d

Fig.16

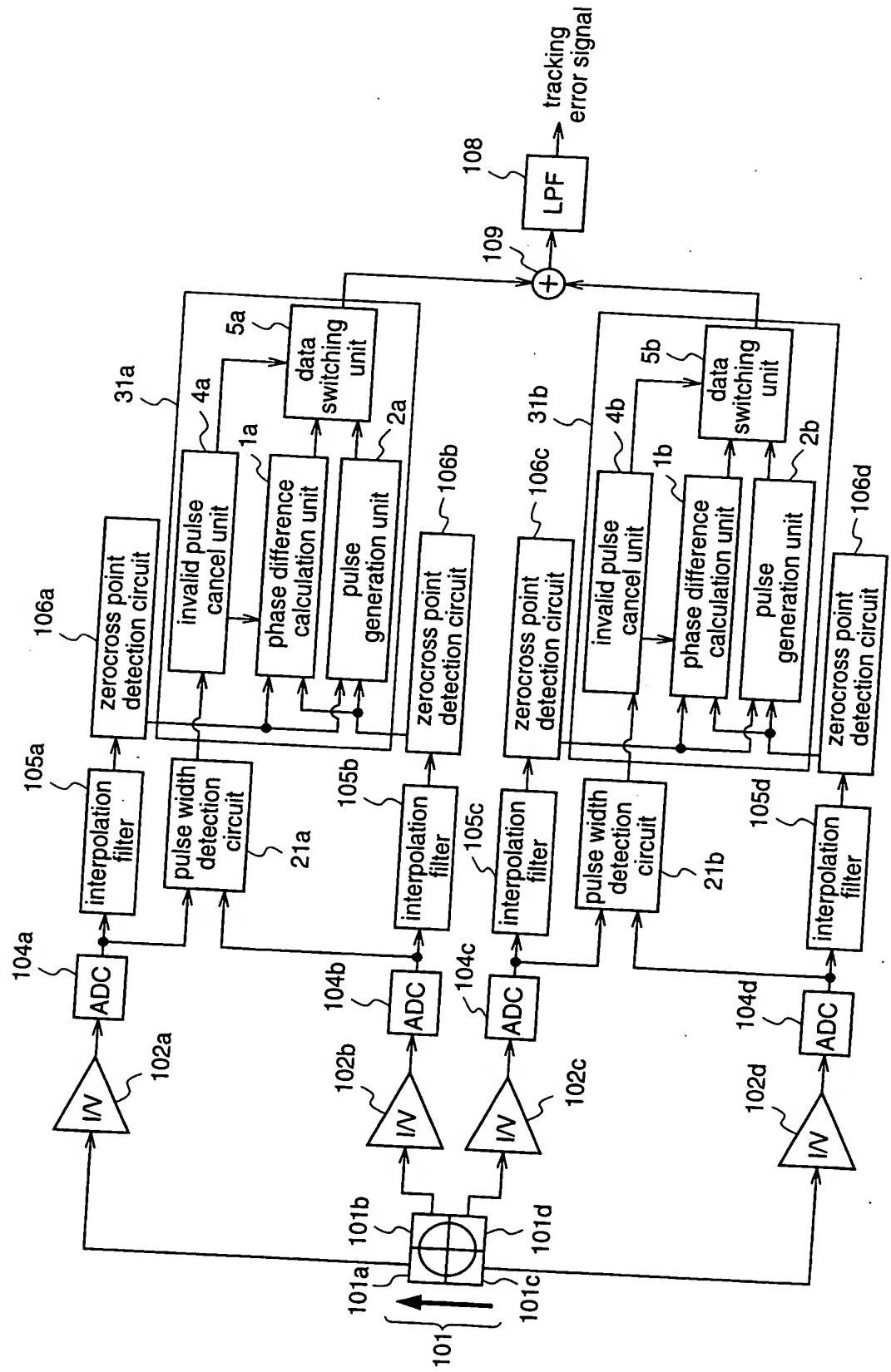
101
101a
101b
101c
101d
I/V
102a
102b
102c
102d
ADC
104a
104b
104c
104d
interpolation filter
105a
105b
105c
105d
pulse width detection circuit
21a
21b
zerocross point detection circuit
106a
106b
106c
106d
31a
31b
invalid pulse cancel unit
1a
1b
phase difference calculation unit
pulse generation unit
2a
2b
4a
4b
data switching unit
5a
5b
109
LPF
108
tracking error signal

Fig.17

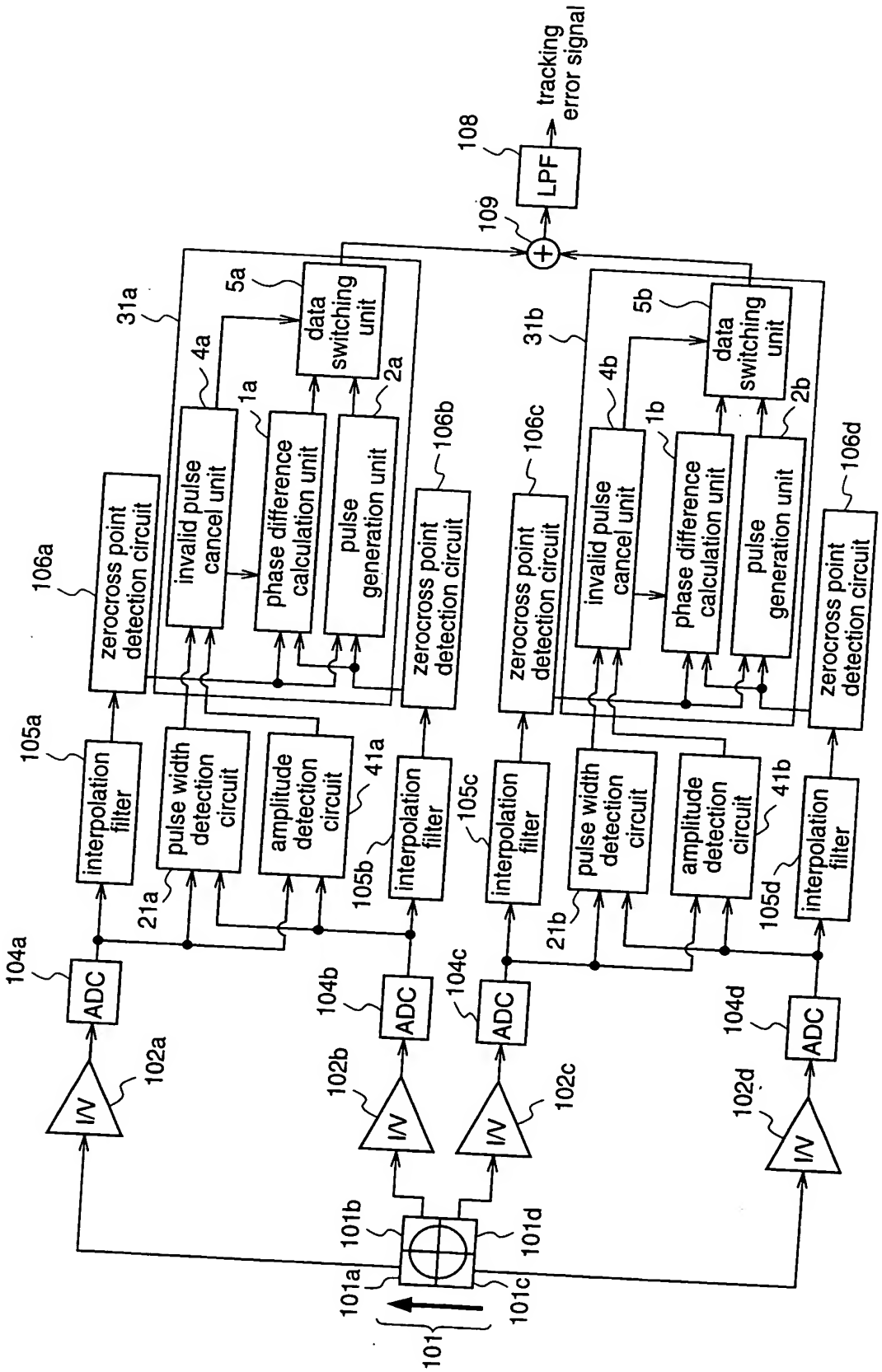
101
101a
101b
101c
101d
I/V
102a
102b
102c
102d
ADC
104a
104b
104c
104d
105a
105b
105c
105d
interpolation filter
21a
21b
pulse width detection circuit
amplitude detection circuit
41a
41b
106a
106b
106c
106d
zerocross point detection circuit
31a
31b
invalid pulse cancel unit
phase difference calculation unit
pulse generation unit
1a
1b
2a
2b
4a
4b
5a
5b
data switching unit
109
108
LPF
tracking error signal

Fig.18

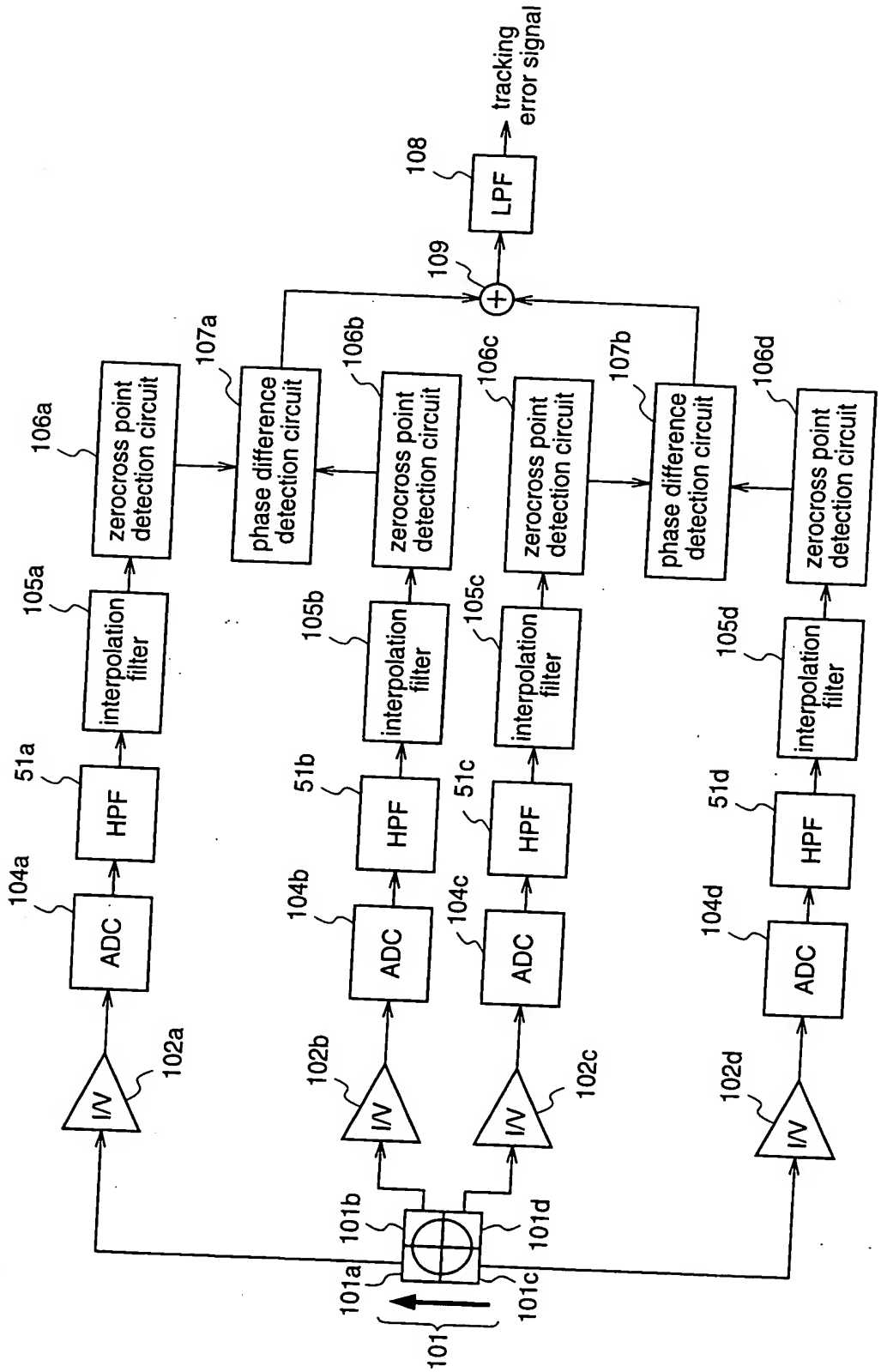
101
101a
101b
101c
101d
102a
102b
102c
102d
I/V
104a
104b
104c
104d
ADC
51a
51b
51c
51d
HPF
105a
105b
105c
105d
interpolation filter
106a
106b
106c
106d
zerocross point detection circuit
107a
107b
phase difference detection circuit
108
LPF
109
tracking error signal

Fig.19 Prior Art

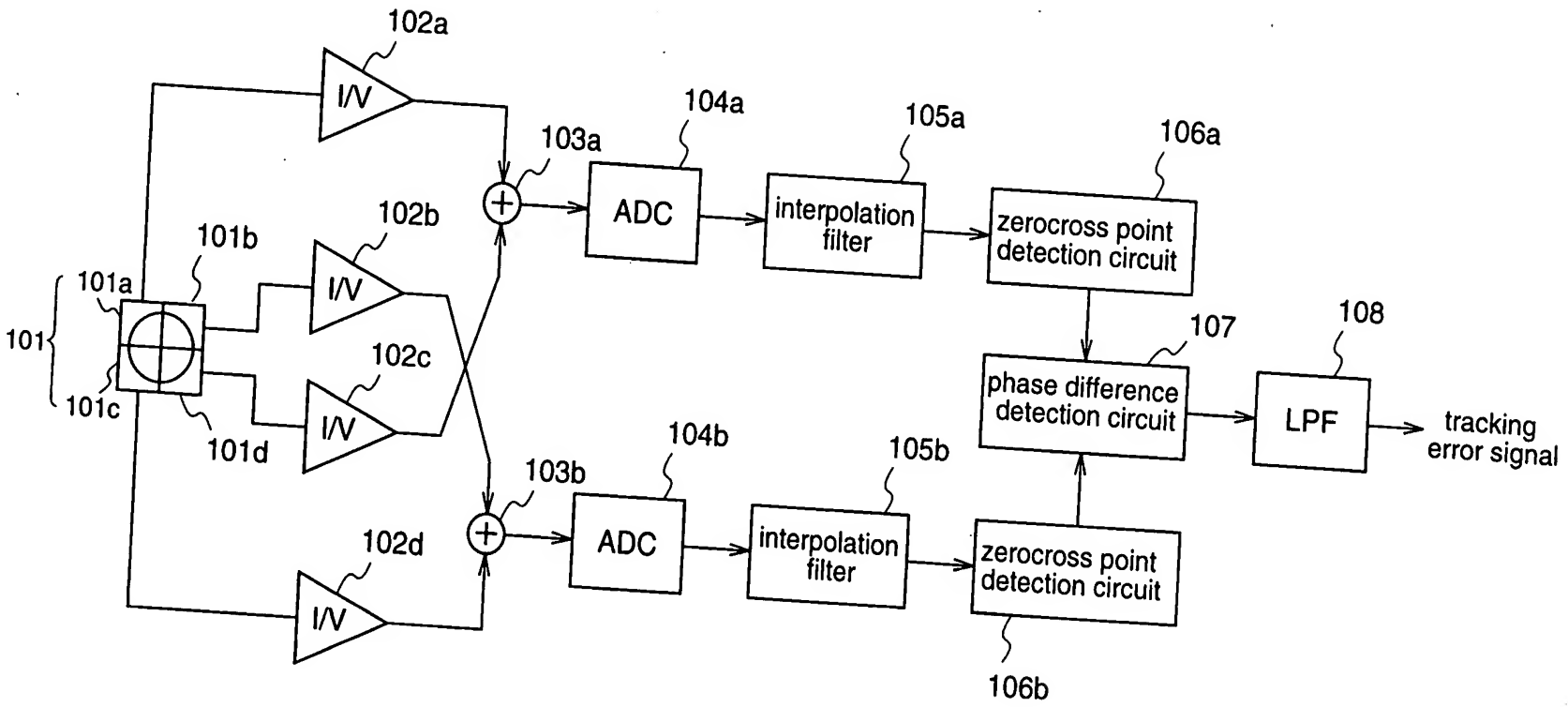

Fig.20 Prior Art

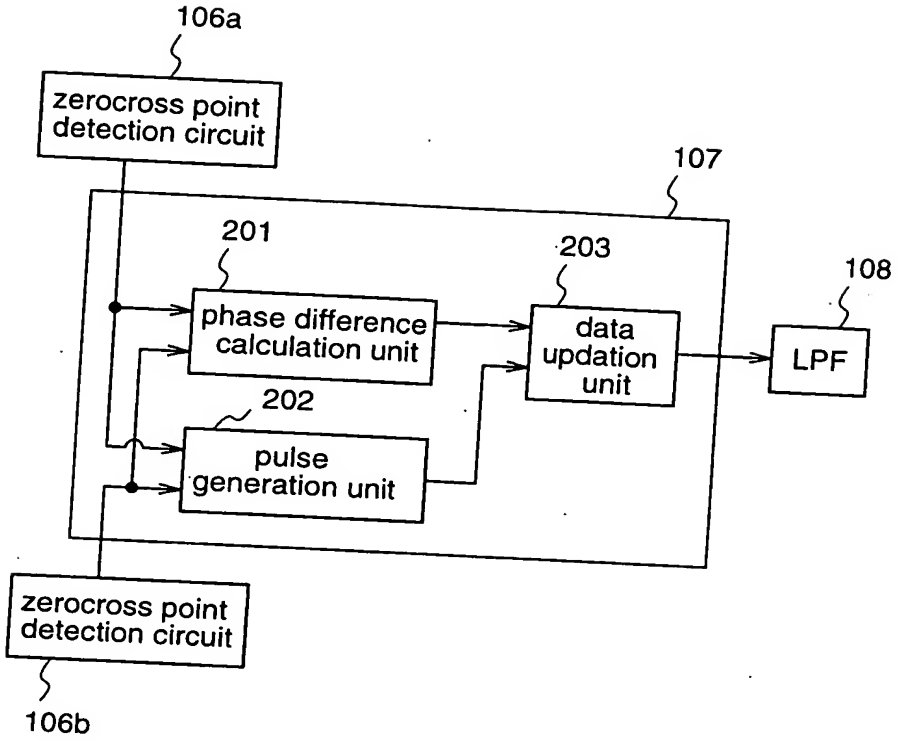

Fig.21 Prior Art

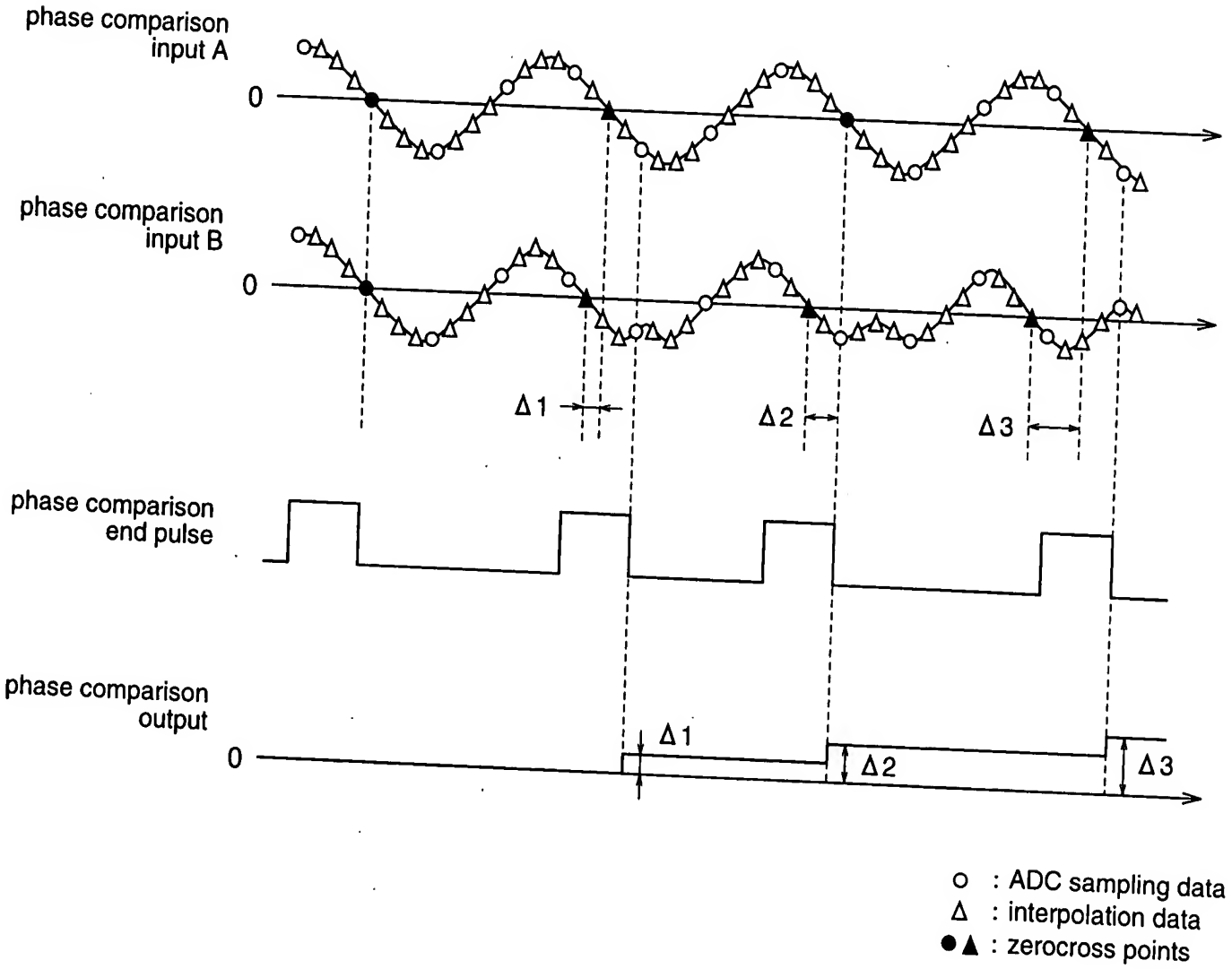

Fig.22 Prior Art

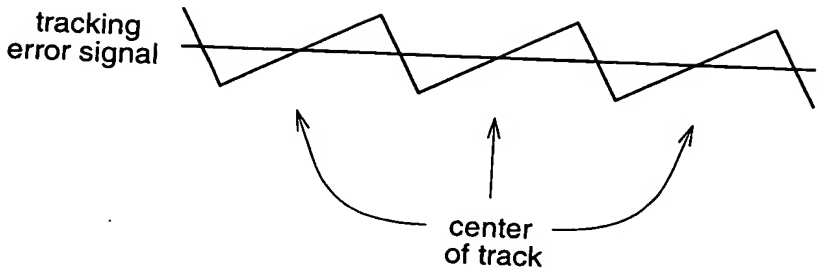

Fig.23(a) Prior Art

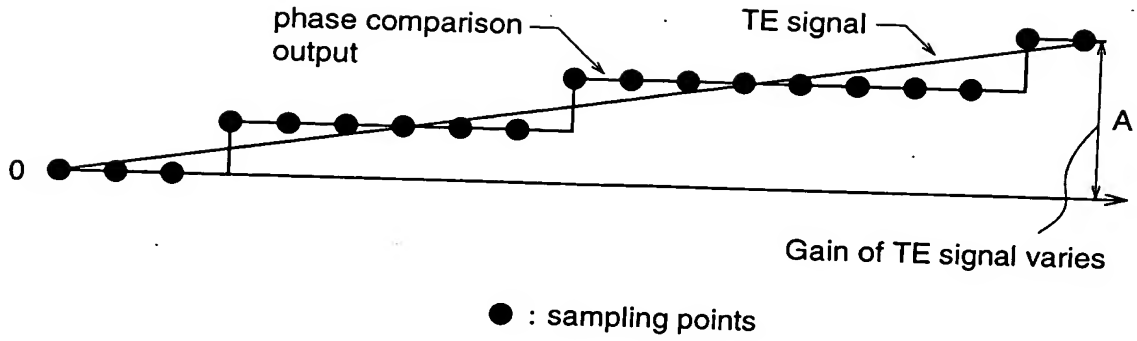
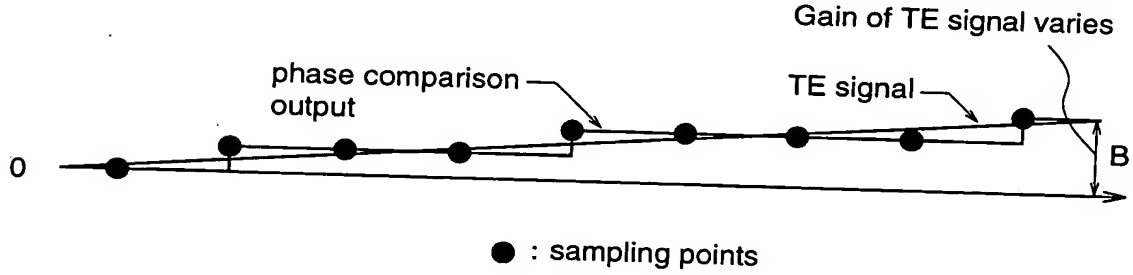
Fig.23(b) Prior Art